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**Beryllium Technology Facility Auditable Safety Analysis
Los Alamos National Laboratory**

1. Facility and Operations Description

The Beryllium Technology Facility is a new facility located within an existing structure at TA-3, Building SM-141. Its purpose is to provide technical capability for weapons production and beryllium research and development in support of the DOE Nonnuclear Reconfiguration Project. The project involves relocating equipment and capability from Rocky Flats to LANL. It also involves reconfiguration of work space within building SM-141 and the relocation and consolidation of beryllium operations currently performed at LANL.

1.1 Existing Facility and Facility Modifications

Building 141, also known as the Rolling Mill Building, is a concrete frame structure with masonry walls that was completed in the early 1960s. The existing facility comprises a number of laboratory, light industrial, and office spaces used in support of current beryllium operations.

The facility occupies about 16,500 square feet. The modification will involve removal of walls and equipment and cleanup of residual contamination from previous operations. Utilities services will be modified, removed, or added to support the revised layout. The existing heating ventilation and air conditioning (HVAC) unit will be removed. New walls will reconfigure the work space. A contract will be let for the modifications the details of which are currently being planned. Existing equipment has been relocated or removed temporarily for

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renovation efforts. When construction efforts are in the final stages, old and new equipment will be installed and tested.

1.2 Proposed Facility Upgrades

The proposed facility includes areas for a variety of operations in support of the expanded beryllium operations. The beryllium operation areas include inspection and nondestructive testing, metallography, alloy development, joining and coating, machining, foundry, and powder operations. The support areas include an analytical laboratory, laundry, primary change room, locker rooms and showers, break room, and office areas. Mechanical systems are located in the mezzanine with the exception of the fans and cartridge-filter house which are located outside the structure.

1.3 Upgrade Features

The modification will result in a new ventilation system, an electrical distribution system that includes a communication/alarm system, plumbing systems, and a seismic upgrade in the facility structure. The new ventilation system will service the entire building and accommodate a larger variety of beryllium operations. A communication system provides alarms and intercom system and ports for electronic transfer of data. The structural upgrade ensures that the modifications satisfy PC-2 requirements for seismic design. A new roof will be built.

New process equipment will be installed which includes both new purchases and equipment transferred from Rocky Flats. Existing process equipment currently located at SM-39 (TA-3-39) and at the Sigma Complex will be relocated.

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Utilities will be modified as required to support new operations. Upgrades to process and ventilation systems will not only result in worker protection but will reduce air emissions and waste generation on a per process basis.

1.4 Safety Systems and Design Features

The primary safety systems are the ventilation system, the fire protection system, communication system, and the process cooling water system. Design features include change room and locker/shower rooms, on-site laundry facilities, and on-site analytical laboratory. These systems and features are described below.

1.4.1 Ventilation System

The function of the ventilation system is as follows:

- Control beryllium at the source of generation,
- Contain generated beryllium particulate for recycle,
- Filter exhausted air as close to the source as possible and prior to exiting the facility,
- Provide dilution ventilation, i.e., dilution of possible contaminated air with uncontaminated air for the purpose of controlling potential airborne particulate,
- Reduce re-suspension of beryllium from surfaces by downward flow of general room exhaust,
- Maintain room pressure differentials for higher hazard operations,
- Transport “used” or “waste” inert gases from the process areas to the exterior of the facility,

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- Provide 100% outside air to eliminate reintroduction of potentially contaminated air into the workplace, and
- Maintain temperature control.

A brief description of the ventilation system design is given below.

1.4.1.1 General

The ventilation system comprises a general room supply and exhaust and two types of local exhausts (low and high pressure). All supplied and exhausted air is filtered.

The general ventilation system has a downward flow with supply diffusers located in the ceiling area (generally 12 foot high) and the exhaust duct inlets near the floor. This design reduces re-suspension of dust or continued reentrainment. The system supplies 100% outside air to the work areas. The fresh air is filtered with 95%-efficient inlet filters which is the standard for hospital surgical room cleanliness. The system will supply 15 air changes per hour. The system is designed to maintain lower general room air pressure for the operations which have a higher potential for generation of airborne particulate in order to reduce the spread of contamination. The break room and offices are kept at positive pressure with respect to the adjacent areas. The supply system for the technical staff member offices is separate from the operating area and is designed to meet American Society for Heating and Air Conditioning Engineers (ASHRAE) Indoor Air Quality standards.

The high-pressure local exhaust system is used when higher capture velocity is

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needed such as machining and powder operations. The system is designed to use a single main duct with individual branches for each piece of equipment and a pressure-controlled inlet valve on the end of the main duct. This design maintains transport velocities in active portions of the duct system during maintenance activities which minimize particulate in the duct system. Flanged connections on the high pressure ducting allow for easier duct work modification and limit the need for maintenance activities that generate sparks (i.e., welding), thereby reducing fire risk. The low-pressure local exhaust system is used for enclosures, hoods, glove boxes, etc. Several access points within both the high- and low-pressure system will allow for checking ducts for loading and thickness (wear).

Avoidance of turbulent flow and vortices within the duct work is a primary feature. Physical layout and duct work installation is an important factor in preventing unwanted beryllium dust accumulation. The system has built-in redundancy with two exhaust fans, a primary fan and stand-by fan. The system has approximately 20% additional capacity. The system is designed for potential expansion into Room 126.

1.4.1.2 Source Control

Custom-designed capture hoods and enclosures contain the beryllium either initially at the point of generation or secondarily by enclosing the operation. Capture hoods will be designed for each applicable operation which may include several different designs per equipment, depending on the operations. Enclosures will trap and exhaust any beryllium particulate that was not initially captured. Enclosures will be kept at a negative pressure with respect to the room at all times.

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Several breakout hoods will be used as secondary controls for drum unloading, vacuum cleaner filter changing, and beryllium powder hopper source control. An air wash down area is used to reduce the potential for inhalation due to beryllium particulate generated from coverall removal. Custom hoods will be designed for personal protective equipment waste barrels.

1.4.2 Filtration

All captured particulate will go through a series of filtration devices. The high pressure system is filtered initially by a local cyclone separator. Cyclone separators will have at least 85% efficiency at 40 to 100 micron particles. Cyclone separators near the beryllium generation points are a key feature to prevent excessive contamination of the ventilation system. Waste material collected by the cyclones will be recycled in the foundry.

Exhausted air from the high-pressure system is filtered through a cartridge filter house. This cartridge filter house is a pulsed-jet dust collection system. Exhausted air enters the collector above the cartridges and is distributed around the filter elements by an air distribution baffle. Heavy particles fall into the collection hopper, while the lighter particles will be deposited on the filter media. The pulsed-jet dust collection system pulsates compressed air to breakout small particulate trapped in the filters. The filter media efficiency is rated at 99.999% at 0.5 μm .

The final filtration step for all exhausted air is through two parallel filter trains each comprised of a fire screen section, 18 HEPA filters, (three high by six wide

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in a single stage), and a test section.

1.4.2.1 Control System

The ventilation system is sophisticated and automatically adjusts to respond to changes in conditions using a Facility Management System (FMS). The control system and its associated components (dampers, sensors, and actuators) are essential for proper operation of the ventilation system to protect workers. The FMS maintains pressure differentials within process areas that limit the spread of airborne beryllium contamination. There are two exhaust fans, one constantly running, the other on standby. A pressure sensing system turns on the standby fan in case of primary fan malfunction. To prevent backflow in case of an unplanned shutdown, automatic dampers will close should the system sense a pressure drop. The FMS will continuously monitor room supply and exhaust air flow quantities and pressures. All information will be logged and saved for documentation on ventilation for each room.

1.4.3 Fire Protection System

The fire protection system consists of

- General room heat detectors located in ceiling areas with wet-pipe sprinkler heads to protect the infrastructure,
- Smoke detectors located prior to each HEPA-filter bank, and
- Thermal heat detectors in the cartridge filter house.

The sensors alarm to the central fire-monitoring station and then the fire

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department. This system services general fire protection similar to other industrial facilities. Fire sensors are also in the filter cartridge house to detect a fire in the exhaust system. The potential for beryllium fires is recognized and will be controlled at the process exhibiting that potential.

The high- and low-pressure exhaust duct systems will be grounded to prevent static charges from building up and igniting particulates. In addition, transport velocities will be maintained by design criteria to reduce dust accumulation in the duct work. Also, practices for reducing the risk of beryllium fire are reviewed in section 3.4.1, Beryllium Fire Hazard.

1.4.4 Communication System

The communication system includes emergency and nonemergency alarms, an intercom, data ports, and in-house video communications. For evacuation purposes, both visible and audible emergency alarms will actuate whenever there is a fire or unplanned shutdown of the ventilation system. The intercom system will allow broadcast (unless there is total power failure) of reason for evacuation or location and extent of concern. Non-emergency alarms will be tied to the building manager's communication system to identify facility operating conditions that are outside established parameters. Data ports are provided to create a paperless system which restricts material removal from process areas. The in-house video communications system allows for viewing of beryllium operations outside of the beryllium operations areas; this reduces the number of individuals who enter the facility.

1.4.5 Facility Design Features

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The following features are in place to reduce and control airborne beryllium concentrations and surface contamination:

- Isolation techniques,
- Smooth surfaces,
- Decontamination room,
- Laundry facilities,
- Cyclones and foundry for waste minimization, and the
- Beryllium analytical laboratory.

1.4.5.1 Isolation Techniques

Isolation techniques such as physical barriers and light locks are used to prevent or reduce beryllium migration. The beryllium operations area and support area are isolated from the outside of the building by the locker/shower room. (see Figure 2). No access is permitted into these areas without an individual's first changing into work clothing. Contaminated coveralls and other personal protective equipment are doffed in the primary change room prior to entering the support area. The technical staff member offices and conference room are isolated from the beryllium operations area.

Light locks consist of two doors separated by a pressure differential. Light locks are similar to air locks; however, door opening is administratively controlled.

There are light locks in the following locations:

- Between the primary change room and the beryllium operations areas,
- Between the receiving area and the beryllium operations area, and

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- Between powder operations and other beryllium operations areas.

The atomization processes and plasma spray operation are enclosed in separate rooms accessed by one light lock.

An additional isolation technique is established through the use of varying room negative pressures. Rooms with the highest hazard potential will be the rooms with the most negative pressure. Therefore, in the event of a spill, contamination will remain in the most hazardous area. All rooms will have isolation dampers installed on both supply and low pressure exhaust ductwork. In the event of a loss of power or mechanical failure, each room will be isolated from one another by isolation dampers that automatically close.

The facility is designed to limit access to only authorized beryllium workers. There is only one entrance to the process area which is through the change/locker room where workers change from their street clothes to work clothes. A badge reader also limits access to the facility.

1.4.5.2 Smooth Surfaces

All surfaces such as walls, floors, and ceilings will be finished with a smooth epoxy to facilitate in the cleaning of surfaces and to prevent dust accumulation. False ceilings built in most locations reduces the cleaning burden and the number of potential areas where dust may accumulate. The powder operations areas, change room, laboratory, and office have false ceilings to prevent particulate buildup on the ceiling support structure, such as I-beams.

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1.4.5.3 Decontamination Room

While high contamination of personnel is not expected, a decontamination room is available. The janitor's closet in the beryllium operations area has a drain and a shower head and is served by hot and cold potable water.

1.4.5.4 Laundry Facilities

On-site laundry facilities contain an industrial-size, front-loading washer and dryer. Used coveralls are placed in a barrel lined with water degradable plastic which is located near the washer. Nondisposable personal protective clothing can be used where applicable, which will minimize waste due to disposal of protective clothing. The industrial dryer is connected to the exhaust ventilation system. There are HEPA filters to capture lint and other particulates to reduce the potential for exhaust ventilation system contamination.

1.4.5.5 Waste Minimization Features

Cyclone collectors are provided for all operations where a higher level of particulate is generated. The particulate will be recycled by use of the foundry. The foundry will also be used to melt scrap for reuse.

1.4.5.6 Beryllium Analysis Laboratory

An on-site laboratory for beryllium analysis is equipped with an inductively coupled plasma spectrometer to provide quick turn-around sample analysis.